

BioE/Chem 598 - "BioMEMS and Medical Microdevices"
1-13-14

Course Abstract: *Our society is on the cusp of a revolution that has potential to change the practice of medicine. Today we face tremendous challenges to provide affordable and effective healthcare to citizens in the US, the world's richest country. In low- and middle-income countries, the complications associated with healthcare delivery are far more complex. Fortunately, microfabrication methods that have empowered electronics for some time now are starting to invade areas of biomedical devices. These state-of-the-art tools provide some hope for their capacity to create more efficient healthcare and wellness delivery mechanisms. Through this transdisciplinary lecture course, students will obtain intimate knowledge of molecular sensors, nanodevices and biomedical microsystems. The course also includes special projects whereby students will establish their own 'virtual company' for the purpose of formulating concepts for new medical microdevices with potential to service significant current unmet clinical needs.*



BioE 598: CRN: **22764**: 3 Credits.
Chem 598: CRN: **22284**: 3 Credits.6

Lecture Time: Tuesday and Thursday @ 9:25 am to 10:40 am
Lecture Location: Bioscience Research Collaborative (BRC) Room #284
Prerequisite (UG): Senior status in natural sciences or engineering major (and consent of the instructor)
Prerequisite (G): Graduate status in natural sciences or engineering discipline
Instructor: John T. McDevitt, Brown-Weiss Professor of BioEngineering & Chemistry
Office: BRC Room #317
Telephone: (713) 348-2123
Email: mcdevitt@rice.edu
Office hour: Tuesday 10:40 am to 11:40 am (i.e. right after lecture) or by appointment, BRC Room #317
Teaching Assistant: Yubo Tang
Email: yubo.tang@rice.edu
Office hours: by appointment

Required Textbook: "Introduction to BioMEMS", Albert Folch, CRC Press, 2013.

Other Useful References:

Fundamentals of BioMEMS and Medical Microdevices, S. S. Saliterman, Wiley, 2006
Micromachined Transducers Sourcebook, Kovacs, McGraw-Hill, 1998
BioMEMS, Urban, Springer, 2007
Fundamental of Microfabrication, Madou, CRC Press 2002
Chemical Sensors and Biosensors, Eggins, Wiley 2002
Biomolecular Sensors, Gizeli and Lowe, Taylor and Francis, 2002

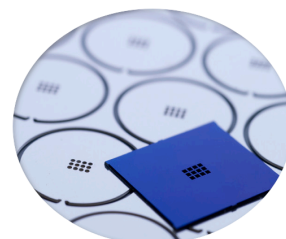
Commercial Biosensors, Ramsay, Wiley 1998

Class URL: <https://owlspace-ccm.rice.edu/portal/site/BIOE-CHEM-598-001-Sp14>
(Rice Owl Space)

Class email list: All course announcements will be sent out through Owl Space.

Grading*

<i>Homework Assignments (2ea):</i>	20%
<i>Exam:</i>	30%
<i>In Class Participation</i>	10%
<i>Venture Project (6ea):</i>	40%



Homework Assignments (20%):

Homework assignments will be delivered at the front-end of the course to ensure understanding of the presented lecture materials and assist students in preparing for the execution of the Venture Projects (see below).

Exam (30%):

A single comprehensive exam will be issued to cover materials in lectures, readings, and homework assignments. The Exam will be completed during the class period of Tuesday April 8, 2014. This is a closed book and closed notes exam.

In Class Participation (10%):

Regular reading assignments will be provided throughout the term. The information included in these reading assignments will augment the materials provided in the lectures. Students will be selected without warning from a group of 'on call students' to provide 5 minute summaries of the key points covered in these papers. The students that will be on call will be rotated on a lecture-to-lecture basis. The on call rotation schedule will be provided to the class via Owl Space. By the end of the term everyone in the class will be expected to have presented a short summary of the reading assignments in front of the class.

Venture Projects (40%):

This course includes a 'venture project' whereby students will establish their own 'virtual company' for the purpose of formulating concepts for new medical microdevices with potential to service significant current unmet clinical needs. These venture projects will include the delivery of a 3 minute 'elevator speech' for the purpose of pitching to the class potential focal points for such a virtual company. The topical areas here discussed should be of interest to you, of general interest to the class and related to the broadly defined field of BioMEMS and Medical Microdevices. Ideally, these topics will be chosen so that there is a compelling societal need that can be uniquely addressed with the chosen BioMEMS approach. The venture projects will be completed during the last half of the term. A total of 6 sub-reports will be completed by each student as follows:

1. Elevator Speech (5%)
2. Executive Summary (5%)
3. Unmet Clinical Needs Assessment Report (5%)
4. Design Concept and Documentation (5%)
5. Final Venture Report (10%)
6. In Class Venture Pitch (10%)

Each of these sub-reports will be described in greater detail using documents that will be released through Owl Space.

Schedule:

The class will most likely stay close to this schedule projected below, but in the event there are changes in plans, the alternative dates for lectures and assignments will be posted on Owl Space along with an email message to the class explaining the change.

The homework assignments, exams and venture reports are due at the beginning of class on the date specified in the course schedule. Late assignments may be graded, but with penalty.

Grading Guidelines:

Letter grades will be assigned based on the following scale:

A	90-100%
B	80-89.9%
C	70-79.9%
D	60-69.9%
F	less than 59.9%

Goals for the Course

- To obtain a knowledge of the basic elements and major classes of molecular sensors, nano-devices and biomedical microsystems (or bioMEMS).
- To demonstrate an understanding of the fundamental principles behind the operation of molecular sensors, nano-devices and biomedical microsystems.
- To understand the unique requirements, environments, and applications of molecular sensors, nano-devices and biomedical microsystems.
- To gain an understanding of standard microfabrication techniques.
- To apply knowledge of microfabrication techniques and applications to the design and manufacturing of such microsystems.
- To secure an appreciation of the unmet clinical needs that may be serviced by the next generation of medical microdevices.
- To acquire an entrepreneurial experience related to medical microdevice technology through the participation in the development of a virtual company in this space.

The term "micro" is interpreted in its classical sense as "tiny", including both MEMS and Nanotechnology. Terms "microsystems", "microsensors", "transducers", "MEMS" will be used interchangeably.

Course Content:

All topics listed below in this handout will be covered in course. Schedule is subject to change and these will be announced in class and on web page. Additional assignments including unannounced quizzes covering the lectures may be made if deemed necessary by the instructor.

BioE/Chem 598: Tentative Schedule (01-13-2014)

Date	#	Day / Task	Topic	Required Reading	Assignments
1/14/2014	1	Tues. / Lecture JTM #1	Course Administration & Introduction to BioMEMS	Chapter 1	
1/16/2014	2	Thurs. / Lecture JTM #2	Scaling Laws	Chapter 3.1 to 3.4	HW#1 Out: Quad Chart
1/21/2014	3	Tues. / Lecture JTM #3	Silicon Microfabrication-Part 1	Lit.- Owl Space	
1/23/2014	4	Thurs. / Lecture JTM #4	Silicon Microfabrication-Part 2	Lit.- Owl Space	HW#1 Due: Quad Chart
1/28/2014	5	Tues. / Lecture JTM #5	Soft Fabrication & Polymers	Chapter 2	HW#2 Out: Literature Reviews
1/30/2014	6	Thurs. / Lecture JTM #6	Microfluidics-Part 1	Chapter 3.5 to 3.11	
2/04/2014	7	Tues. / Lecture JTM #7	Microfluidics-Part 2	Lit.- Owl Space	HW#2 Due: Lit. Rev.
2/06/2014	8	Thurs. / Lecture #GL	Guest Lecture		
2/11/2014	9	Tues. / Lecture JTM #8	Sensor Principles-Part 1	Lit.- Owl Space	Ven. Rpt. #1 Out: Elev. Sp.
2/13/2014	10	Thurs. / Lecture JTM #9	Sensor Principles-Part 2	Lit.- Owl Space	
2/18/2014	11	Tues. / Lecture #SL	Student In Class Elevator Speeches	--	Ven. Rpt. #1 Due: Elev. Sp.
2/20/2014	12	Thurs. / Lecture JTM #10	Clinical Laboratory Medicine	Lit.- Owl Space	Ven. Rep. #2: Exec. Sum. Out
2/25/2014	13	Tues. / Lecture JTM #11	Micro Total Analysis Systems - Lab-on-a-Chip	Lit.- Owl Space	
2/27/2014	14	Thurs. / Lecture JTM #12	Genomics and DNA Microarrays	Lit.- Owl Space	Ven. Rep. #2: Exec. Sum. Due
3/04/2014	--	<i>Tues. / no Lecture</i>	<i>Spring Break</i>		Ven. Rep. #3: Needs Assmnt. Out
3/06/2014	--	<i>Thurs. / no Lecture</i>	<i>Spring Break</i>		
3/11/2014	15	Tues. / Lecture JTM #13	Proteomics and Protein Microarrays	Chapter 4	Ven. Rep. #3: Needs Assmnt. Due

3/13/2014	16	Thurs. / Lecture JTM #14	Emerging BioMEMS Platforms	Lit.- Owl Space	Ven. Rep. #4: Design Rep. Out
3/18/2014	18	Tues. / Lecture JTM #15	Electronic Nose and Taste	Lit.- Owl Space	
3/20/2014	19	Thurs. / Lecture JTM #16	Nano-Bio-Chips: Cellular Processing Units (HIV, Cancer)	Chapter 5	Ven. Rep. #4: Design Rep. Due
3/25/2014	20	Tues. / Lecture JTM #17	Bio-Nano-Chips: Chemical Processing Units	Lit.- Owl Space	Ven. Rep. #5: Final Rep. Out
3/27/2014	21	Thurs. / Lecture JTM #18	Bench to Bedside Story	Lit.- Owl Space	
4/01/ 2014	22	Tues. / Lecture JTM #19	Intellectual Property: Patents and IP	Lit.- Owl Space	Ven. Rep. #5: Final Rep. Due
4 /03/ 2014	--	<i>Thurs. / no Lecture</i>	<i>Midterm Recess</i>		
4/8/2014	23	Tues. / Exam	In Class Exam	--	
4/10/2014	24	Thurs.	Student Lectures #1-4	--	Ven. Rep. #6 Due (1-4)
4/15/2014	25	Tues.	Student Lectures #5-8	--	Ven. Rep. #6 Due (5-8)
4/17/2014	26	Thurs.	Student Lectures #9-12	--	Ven. Rep. #6 Due (9-12)
4/22/2014	27	Tues.	Student Lectures #13-16	--	Ven. Rep. #6 Due (13-16)
4/24/2014	28	Thurs.	Student Lectures #17-20	--	Ven. Rep. #6 Due (17-20)